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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/719,759	11/20/2003	Chin-Ta Su	P910229	3129
33197	7590	04/22/2008		
STOUT, UXA, BUYAN & MULLINS LLP 4 VENTURE, SUITE 300 IRVINE, CA 92618			EXAMINER MCDONALD, RODNEY GLENN	
			ART UNIT	PAPER NUMBER
			1795	
			MAIL DATE	DELIVERY MODE
			04/22/2008	PAPER

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**BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES**

Application Number: 10/719,759  
Filing Date: November 20, 2003  
Appellant(s): SU, CHIN-TA

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Peter B. Martine  
For Appellant

**EXAMINER'S ANSWER**

This is in response to the appeal brief filed January 28, 2008 appealing from the Office action mailed September 7, 2007.

**(1) Real Party in Interest**

A statement identifying by name the real party in interest is contained in the brief.

**(2) Related Appeals and Interferences**

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

**(3) Status of Claims**

The statement of the status of claims contained in the brief is correct.

**(4) Status of Amendments After Final**

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

**(5) Summary of Claimed Subject Matter**

The summary of claimed subject matter contained in the brief is correct.

**(6) Grounds of Rejection to be Reviewed on Appeal**

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

**(7) Claims Appendix**

The copy of the appealed claims contained in the Appendix to the brief is correct.

**(8) Evidence Relied Upon**

6,388,327	GIEWONT et al.	5-2002
5,970,370	BESSER et al.	10-1999

**(9) Grounds of Rejection**

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1, 2, 7, 8 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Giewont et al. (U.S. Pat. 6,388,327).

Regarding claims 1, 7, 8, 13, Giewont et al. teach a conventional process for formation of a cobalt silicide comprising providing a substrate having a silicon layer thereon. Precleaning the substrate. Depositing a cobalt layer thereon. Depositing a TiN capping layer on the cobalt. The conventional capping layer is not truly stoichiometric but includes additional nitrogen. (i.e. Nitrogen greater than 1 thus the TiN layer has x atoms of nitrogen for each atom of titanium greater than 0.9) . The structure is first annealed in the range of 480 to 570 degrees C. Since the capping layer includes additional nitrogen, nitrogen will diffuse into and through the cobalt layer 2 during the first anneal. During the first anneal, the Co diffuses into the silicon to form a layer of CoSi<sub>12</sub>. Also, the nonreacted Co layer 22 is formed. The TiN layer and the unreacted Cobalt layer is removed leaving a layer of CoSi. A second anneal can then be carried out to form a layer of CoSi<sub>2</sub> in the range of 690 to 750 degrees C. The CoSi<sub>2</sub> is inherently decreased in resistance. (Column 1, lines 23-41; Column 2, lines 1-16 and lines 28-51) The Ti is minimally diffused from the TiN<sub>x</sub> layer into the silicon layer due to the layer thickness of the TiN<sub>x</sub> layer being "about 200 Angstroms". (Column 2, lines 1-2) The TiN layer is formed by a sputtering process. (Column 1, lines 35-37) The gas used in the sputtering process is N<sub>2</sub> and Ar. (Column 1, lines 35-41)

Regarding claim 2, the second thermal process is performed after removing the non-reactive cobalt layer. (Column 2, lines 47-50)

The difference not yet discussed is the ratio of the nitrogen to argon gas being "approximately 3:1".

Giewont et al. teach that to form a titanium nitride film with excess nitrogen one should operate in region III. (See Fig. 2) The nitrogen flow can be increased above 60 sccm to achieve applicant's gas ratio. (See Fig. 2)

The motivation for operating with a N<sub>2</sub> to Ar ratio of 3:1 is that it allows formation of a film that has excess nitrogen. (Column 2, lines 29-31)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized a ratio of 3:1 as taught by Giewont et al. because it allows formation of a film with excess nitrogen.

Claims 6, 12 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Giewont et al. (U.S. Pat. 6,388,327) in view of Besser et al. (U.S. Pat. 5,970,370).

Giewont et al. is discussed above and all is as applies above. (See Giewont et al. discussed above)

The difference between Giewont et al. and the present claims is the thickness of the TiN<sub>x</sub> layer.

Regarding claims 6, 12, 17, the thickness of the TiN layer can be 100 Angstroms. (Column 5, lines 48-51)

The motivation for utilizing a particular thickness of the TiN layer is that it allows for formation of a cobalt silicide structure. (See Abstract)

Therefore, it would have been obvious to one of ordinary skill at the time the invention was made to have modified Giewont et al. by utilizing a particular thickness of the TiN layer as taught by Besser et al. because it allows for formation of a cobalt silicide structure.

**(10) Response to Argument**

**A.) Response to the arguments of Claims 1, 2, 7, 8, and 13 as rejected under 35 U.S.C. 103 as being unpatentable over Giewont et al. (U.S. Pat. 6,388,327):**

In response to the argument that Giewont et al. do not teach Appellant's claimed ratio of N<sub>2</sub> to Ar (i.e. 3:1), it is argued that Appellant's claimed ratio of N<sub>2</sub> to Ar can be "approximately" 3:1. Giewont et al. teach a ratio of N<sub>2</sub> to Ar to be 1.5 (i.e. 60 sccm N<sub>2</sub>/40 sccm Ar of Fig. 2) which can be construed to be "approximately" 3:1. However, one of ordinary skill in the art would have known to operate in Region III of Fig. 2 and using more nitrogen than 60 sccm in order to produce a TiN<sub>x</sub> layer having excess nitrogen. Giewont et al. at Column 2, lines 28-30 teach the TiN<sub>x</sub> should include excess nitrogen and at Column 2, lines 30-41 teach that excess nitrogen diffuses into the Co layer improving thermal stability to agglomeration. (See Giewont et al. discussed above)

In response to the argument that Giewont et al. teach the involvement of nitrogen in the cobalt silicide formation process has an undesirable effect of producing an oxynitride, it is argued that the claims do not prohibit the use of an oxynitride layer and the argument concerning the oxynitride layer is not commensurate in scope with

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Appellant's claimed language (i.e. prohibiting an oxynitride layer). Furthermore, Giewont et al. suggest that the oxynitride "may result" which means that it won't necessarily happen although as shown by Giewont et al. in the process of Figs. 4A-4D an oxynitride layer appears. (See Giewont et al. discussed above)

In response to the argument that Giewont et al. do not teach avoiding the formation of an oxynitride layer between the cobalt and the silicon, it is argued that the claims as written do not preclude the use of an oxynitride layer as discussed above and the argument concerning the oxynitride layer is not commensurate in scope with Appellant's claimed language (i.e. prohibiting an oxynitride layer). (See Giewont et al. discussed above)

In response to the argument that Giewont et al. teach away from the present invention because Giewont et al. teach formation of an oxynitride layer, it is argued that Giewont et al. do not teach away from the present invention because the excess nitride that produces the oxynitride helps to improve thermal stability to agglomeration. (Giewont et al. Column 2, lines 35-36)

In response to the argument that Giewont et al.'s other embodiments teach away from Appellant's invention, it is argued that the Examiner has relied upon only the "Conventional Process" at Column 2 of Giewont et al. in the rejection and has not relied upon Giewont et al.'s other embodiments. Giewont et al.'s "Conventional Process" does not teach away from Appellant's invention because Giewont et al. require excess nitrogen in the  $TiN_x$  layer of the "Conventional Process" which is precisely what Appellant's require for their salicide process. (See Giewont et al. discussed above)

In response to the argument that Giewont et al. would not use additional nitrogen in the  $\text{TiN}_x$  layer by increasing Giewont et al.'s nitrogen to argon ratio during sputtering because it would result in the formation of an undesirable oxynitride layer, it is argued that Giewont et al. teach that the additional nitrogen helps improve thermal stability to agglomeration, and therefore, one would use additional nitrogen to produce a layer with excess nitrogen. (See Giewont et al. discussed above)

In response to the argument that there is no motivation to increase the ratio of  $\text{N}_2$  to Ar from 1.5 to 3, it is argued that the motivation for increasing the amount of nitrogen is that it improves thermal stability to agglomeration when depositing the  $\text{TiN}_x$  layer. (See Giewont et al. discussed above)

**B.) Response to the arguments of Claims 6, 12, and 17 as rejected under 35 U.S.C. 103 as being unpatentable over Giewont et al. (U.S. Pat. 6,388,327) in view of Besser (U.S. Pat. 5,907,370):**

In response to the argument that dependent claims 6, 12 and 17 are patentable over Giewont et al. for at least the same reasons set forth above in section A, it is argued that dependent claims 6, 12 and 17 are unpatentable for at least the same reasons as discussed in section A above and Besser teach the required thickness for the  $\text{TiN}_x$  cap layer.

In response to the argument that Besser does not make up for the deficiencies of Giewont et al., it is argued that Giewont et al. teach the claimed subject matter as discussed in section A above and Besser was relied upon to teach the thickness for the  $\text{TiN}_x$  cap layer.



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**(11) Related Proceeding(s) Appendix**

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/Rodney G. McDonald/

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